Early humans saw black hole light in the night sky | New Scientist

Video: Powerful jets spew out of black hole

Did jets from a black hole blow giant bubbles?

(Image: David A. Aguilar/CFA)

Editorial: “Black-hole eruption nearby is a warning for us all“

Some 2 million years ago, around the time our ancestors were learning to walk upright, a light appeared in the night sky, rivalling the moon for brightness and size. But it was more fuzzball than orb. The glow came

from the supermassive black hole at our galaxy's heart suddenly exploding into life.

This novel picture emerges from work announced this week at a conference in Sydney, Australia, which ingeniously pieces together two seemingly unrelated, outstanding galactic puzzles.
As well as offering a welcome way to solve both, it gives us an unexpected glimpse of how the cosmos might have appeared to Earthlings 2 million years ago (see "Which species saw the flare?"). "That is when we had *Homo erectus* running around Earth," says Joss Bland-Hawthorn of the University of Sydney, who led the team behind the work.

It also paints supermassive black holes as unpredictable, and capable of generating some of the brightest flares in the universe, almost on a whim. That in turn throws up the possibility of modern humans being treated to a similar sight sometime in the future – thankfully we are too far away for a flare-up to pose a risk.

Blowing bubbles

It may sound strange to talk about supermassive black holes as the source of the brightest lights in the universe. But this is why the centres of some galaxies, known as active galactic nuclei or AGN, shine so brightly. The idea is that as the supermassive black hole pulls matter in, this matter accretes in a surrounding disc, heats up and starts glowing. When large amounts of matter get pulled into the disc, energy is released as bright jets of particles perpendicular to the black hole's spin.

The Milky Way's central black hole, called Sagittarius A*, is currently docile, but no one knows exactly what makes a black hole turn into an AGN. One clue that our galaxy wasn't always quiet came in 2010, when

astronomers using NASA's Fermi gamma-ray satellite spotted a pair of spectacular but mysterious structures now called the Fermi bubbles, towering 25,000 light years above and below the galactic plane. Theories to explain the bubbles range from gamma rays emitted by annihilating dark matter to supersonic winds unleashed by intense bursts of star formation.

Then in April, at a meeting at Stanford University in California, Bill Mathews and Fulai Guo of the University of California, Santa Cruz, argued that the bubbles were caused by an outburst from Sagittarius A*. Their simulations showed that two intense jets of high-energy particles, like those produced by an AGN, streaming out from the vicinity of the black hole could have created the bubbles. The flare-up, they calculated, would have happened between 1 and 3 million years ago and lasted a few hundred thousand years (arxiv.org/abs/1103.0055v3).

Bland-Hawthorn, who was present, heard this and immediately realised that such an outburst might solve another longstanding mystery. In 1996, astronomers discovered that a section of the Magellanic stream – a fast-moving flow of mainly hydrogen gas about 240,000 light years from the Milky Way – is glowing about 10 to 50 times as brightly as the rest. "We have never known the cause," he says.

Hydrogen light

Could the same explosion that blew up the Fermi bubbles be responsible? After all, the bright part of the stream lies below the galactic centre.

To investigate, Bland-Hawthorn teamed up with other astronomers including Gregory Madsen of the University of Cambridge, who has studied the Magellanic stream for years. "Our telescope was picking up the signature that a lot of ultraviolet light must have illuminated the stream at

some point," says Madsen. A blast of UV light could explain why part of the stream was glowing, as it can rip apart hydrogen atoms, which then recombine, emitting light in the process.

Based on data from other galaxies with supermassive black holes that are actively spewing jets, the researchers worked out that if Sagittarius A* had been similarly active, the resulting UV light would indeed have ionised – and therefore lit up– part of the Magellanic stream (see diagram).

They then calculated the timing and energy of such an outburst, based on the time it would take for the UV light to reach the stream, the decay in the intensity of hydrogen emissions over time, and the time it takes for the emissions to reach us. It tallied well with Mathews and Guo's work to explain the Fermi bubbles (arxiv.org/abs/1309.5455).

Freaking out

So an AGN at the centre of our galaxy around 2 million years ago potentially solves two mysteries at once. What's more, it might also support an emerging view of supermassive black holes.

Many theorists say that AGNs happen only when galaxies merge. But the Milky Way hasn't had a merger for billions of years, so it seems like it is possible to get an AGN in other circumstances.

That echoes recent modelling work by Greg Novak of the Paris

Observatory in France and Jeremiah Ostriker of Princeton University. They suggest that AGNs can be triggered by galactic gas moving inward after cooling by a large amount, and by unstable discs of gas and dust that break apart and fall towards the black hole (*The Astrophysical Journal*, doi.org/fngbsd). That would make AGN flare-ups much more erratic and unpredictable.

Novak is excited by the latest work. "It indicates that just a few million years ago– an instant in galactic terms – the Milky Way had a really major outburst of AGN activity. Amazing!" he says.

It is possible that Sagittarius A* could go AGN again, says Bland-Hawthorn. That would be catastrophic for any worlds near the galactic centre. But modern Earthlings, like their ancestors, would simply see a beautiful, though strange, sight. "You'd really be freaked out," he says.

Which species saw the flare?

In a twist for our galaxy's history, it seems the Milky Way's black hole flared up 2 million years ago, forming a bright moon-sized smudge in Earth's southern sky. Who – or what – saw it?

Two million years ago was an important time in human evolution, says anthropologist Chris Stringer of the Natural History Museum in London. "It was the beginning of the genus Homo. Stone toolmaking had already begun, but the brain was only beginning to enlarge."
Homo erectus emerged around 1.9 million years ago, so would have had a ringside view if the black hole erupted then. Any earlier and *Homo habilis*, the first of our large-brained ancestors, would have watched wide-eyed. It might even have been *Australopithecus sediba*, a close relative whose fossils were recently discovered in South Africa.

Before that, the likely spectator was *Australopithecus africanus*. None of these creatures would have immortalised what they saw as art, though. "The majority opinion is that artistic behaviour only comes within the last 100,000 years," says Stringer.

Since the galactic centre is visible mainly from the southern skies, only creatures living south of 20° above the equator would have seen it. Most of our upright ancestors would have roamed such latitudes.

This article will appear in print under the headline "Early people saw black hole's light"